



CASE STUDY: ANAEROBIC MEMBRANE BIOREACTOR (ANMBR) SYSTEM TREATING HIGH-STRENGTH, HIGH-SOLIDS FOOD PROCESSING WASTEWATER

Wilson, Dwain R.^{1,2}, Grant, Shannon R.¹, Allison, Mike J.¹, and Mi, ZaiYan ¹,
¹ Evoqua Water Technologies, 370 Wilsey Road, Fredericton, New Brunswick, Canada E3B 6E9
² dwain.wilson@evoqua.com

1 Introduction

Ken's Foods manufacturing company has been making salad dressing, sauces, and marinades for over 60 years. Their production facilities include locations in Massachusetts and Georgia. Its high-strength industrial wastewater contains high chemical oxygen demand (COD), high biological oxygen demand (BOD), high total suspended solids (TSS), and fat, oil, and grease (FOG) concentrations. Original wastewater treatment at the Georgia location used a conventional approach including the removal of FOG and suspended solids via dissolved air flotation (DAF), followed by an activated sludge system and a centrifuge system for sludge dewatering.

Considering the requirements of plant production expansion, land space limitation, and the desire for renewable energy utilization, cutting-edge anaerobic membrane bioreactor (AnMBR) technology was selected as a means to upgrade the original wastewater treatment system to handle the flow and load expansion.

The first commercial full-scale AnMBR system in North America was installed at Ken's Foods Marlborough plant in Massachusetts in July 2008, to treat high-strength industrial wastewater with high concentrations of organics, suspended solids, and FOG. Nearly ten years of successful continuous operation of the Marlborough AnMBR system gave Ken's Foods confidence that this solution would also work at other locations. Therefore, Ken's Foods once again selected ADI AnMBR technology for a second production plant located in McDonough, Georgia, USA. The McDonough plant AnMBR system was built in 2017, and is one of the world's largest AnMBR installations in terms of design flow and organic load.

2 ADI-AnMBR Technology

The state-of-the-art AnMBR technology, successfully commercialized for full-scale applications in 2000, is the latest innovation in biological wastewater treatment. The AnMBR process incorporates anaerobic digestion and membrane filtration in one process that effectively treats high-strength wastewater within a compact footprint. The near-absolute (zero TSS) membrane barrier performs the gas-liquid-solids separation to ensure efficient system operation and stability and produces a superior effluent quality while maximizing the biogas production, which can be used as a renewable fuel source.

3 Ken's Marlborough Plant

The AnMBR system at Ken's Foods Marlborough plant was commissioned in July 2008. The AnMBR system consists of an existing anaerobic reactor (ADI-BVF[®]) plus four membrane tanks, equipped with submerged membrane units. It was designed to treat 125,000 gpd of raw wastewater with 39,000 mg/l

COD, 18,000 mg/l BOD, 12,000 mg/l TSS, and 1,500 mg/l FOG (at the time of design). The required effluent discharge limits for BOD and TSS are 400 lb/d and 500 lb/d (equivalent to 380 mg/l BOD and 480 mg/l TSS at design flow) for discharge to the local POTW.

4 Operating Result

During nine years of operation, influent flow has progressively increased from 68,600 gpd in 2008 to 105,600 gpd in 2017. The COD load also increased rapidly and consistently over nine years of operation, from 23,000 lb/d in 2008 to 42,200 lb/d in 2017. The AnMBR effluent COD concentration was consistently low, with an overall average concentration of 272 mg/l, corresponding to an overall average COD removal of 99.2 percent, demonstrating the superior robustness and stability of AnMBR technology.

Table 1: Influent COD, Effluent COD, and COD Removal Efficiency

Year	Influent COD (mg/l)	Effluent COD (mg/l)	COD Removal Efficiency (%)
2008 (July – Dec)	32,740	186	99.2
2009	34,020	217	99.3
2010	34,000	272	99.1
2011	40,640	258	99.3
2012	41,050	261	99.3
2013	43,330	349	99.0
2014	43,170	311	99.2
2015	40,220	309	99.2
2016	37,240	252	99.3
2017	40,410	253	99.4
Overall Average	39,000	272	99.2

5 Ken's McDonough Plant

The McDonough plant is very similar in terms of production and production lines with the Marlborough, MA plant. ADI expects similar wastewater characteristics at the McDonough plant and uses a design flow of 200,000 gpd, and a COD concentration of 60,000 mg/l, respectively, for full-scale treatment design.

The AnMBR system includes an anaerobic continuously stirred-tank reactor (CSTR), two anaerobic membrane tanks, and a biogas collection, transmission, and flare system and is expected to provide the same excellent system performance as it has at the Marlborough plant (low effluent COD and TSS concentrations of <500 mg/l and <10 mg/l, respectively).

5.1 Operating Results

The AnMBR system was started up in November 2017. The raw influent COD load on AnMBR system is 54,000 lb/d with an average COD concentration of 40,000 mg/l (Dec. 2017 – present). The effluent COD concentrations for AnMBR permeate and final effluent are averaged at 330 mg/l and 250 mg/l respectively (Dec. 2017 – present).

The elimination of a DAF unit and aeration basins will significantly reduce chemical additions (e.g. coagulant, cationic and anionic polymer, and macronutrients) associated with aerobic system operations, and the hauling/disposal of skimmed FOG, further reducing operating and maintenance costs.

6 Concluding Remarks

The AnMBR systems allow Ken's Foods to achieve plant expansion, generate a green energy source from its wastewater, significantly reduce operating costs, and ensure the final effluent complies with municipal discharge requirements.

The AnMBR technology at Ken's Food production plants demonstrate that this technology is an ideal solution for industrial processors facing more stringent discharge limits, seeking a renewable energy source, minimal operating costs, simpler operations, and greater water recycling opportunities.